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Mr. A. S. Kent, of San Rafael, California, who for many years, on account of his health, spent several months each year in camp life in the mountains, principally hunting the deer, informed me that he once purchased a couple of cubs of the grizzly bear, which he took into camp with him. One of these proved very docile and tractable, and seemed fond of his attention and society, and usually slept contentedly at his feet. The other seemed possessed of a much more vicious disposition, and he was obliged to kill it. Possibly this might have been overcome by patient care and judicious training.

There is no doubt that different dispositions among these animals as among most other, may be met with.

Mr. Kent's observations tend, in some degree at least, to confirm those of Mr. Adams.

May we not hope that some one with the necessary taste and proper facilities will try experiments and give us the benefit of their observations?

A complete monograph of any one of our species of bears under all conditions would be a valuable addition to our zoölogical literature.

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ON THE NATURE AND ORIGIN OF THE SO-CALLED "SPIRAL THREAD" OF TRACHEÆ.

BY A. S. PACKARD.

WHILE we owe to Professor O. Bütschli the discovery of the mode of origin and morphology of the tracheæ, which as he has shewn[1] arise by invaginations of the ectoblast; there being originally a single layer of epiblastic cells concerned in the formation of the tracheæ; we are indebted to Professor A. Weismann[2] for the discovery of the mode of origin of the "intima," from the epiblastic layer of cells forming the primitive foundation of the tracheal structure. We are also indebted to Weismann for the discovery of the mode of origin of the terminal tracheal cells.

Weismann did not observe the earliest steps in the process of formation of the stigma and main trunk of the tracheæ, which Bütschli afterwards clearly described and figured.

Weismann, however, thus describes the mode of development of the intima; after describing the cells destined to form the peritoneal membrane, he says: "The lumen is filled with a clear fluid and already shows a definite border in a slight thickening of the cell-wall next to it.

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[1] Zur Entwicklungsgeschichte der Biene. Zeit. wissen. Zoologie, XX, 519, 1870.

[2] Die Entwicklung der Dipteren im Ei. Zeit. wissen. Zoologie, XIII, 1863.

"Very soon this thickening forms a thin structureless intima, which passes as a delicate double line along the cells, and shows its dependence on the cells by a sort of adherence to the rounded sides of the cells (Taf. VII, 97 A, *a b c*). Throughout the mass, as the intima thickens, the cells lose their independence, their walls pressing together and coalescing, and soon the considerably enlarged hollow cylinder of the intima is surrounded by a homogeneous layer of a tissue, whose origin from cells is recognized only by the regular position of the rounded nuclei (Taf. VII, fig. 97 B).

"Then as soon as the wavy bands of the intima entirely disappear and it forms a straight cylindrical tube, a fine pale cross striation becomes noticeable (VII, 97, B, *int*), which forms the well-known 'spiral thread,' a structure which, as Leydig has shown, possesses no independence, but arises merely from a partial thickening of the originally homogeneous intima.

"Meyer's idea that the spiral threads are fissures in the intima produced by the entrance of air is disproved by the fact that the spiral threads are present long before the air enters. Hence the correctness of Leydig's view, based on the histological structure of the tracheæ, is confirmed by the embryological development, and the old idea of three membranes, which both Meyer and Milne-Edwards maintain, must be given up."

Weismann also contends that the elastic membrane bearing the "spiral thread" is in no sense a primary membrane, not corresponding histologically to a cellular membrane. On the contrary, the "peritoneal membrane comprises the primary element of the trachea; it is nowhere absent, but envelops the smallest branches as well as the largest trunks, only varying in thickness, which in the embryo and the young larva of Musca stands in relation to the thickness of the lumen."

The trachea, then, consists primarily of an epithelial layer, the "peritoneal membrane" or the invaginated epiblast; from this layer an intima is secreted, just as the skin or cuticle is secreted by the hypodermis. We may call the peritoneal membrane the *ectotrachea*, the intima or inner layer derived from the ectotrachea the *endotrachea;* we hope to show that the so-called "spiral thread" is not spiral in arrangement but simply thickenings of the endotracheal membrane, parallel to each other, not necessarily continuous nor arranged in a spiral manner. For these chitinous bands we would suggest the name *tænidia* (Greek, little bands).

Our observations have been made on the larva of a species of *Datana*, which was placed in alcohol, just before pupation, when the larva was in a semi-pupal condition, and the larval skin could be readily stripped off. At this time the ectotrachea of the larva had undergone histolysis, nothing remaining but the molted endotrachea, represented by the tænidia, which lay loosely within the cavity of the trachea. The ectotrachea or peritoneal membrane of the pupa was meanwhile in process of formation; the nuclear origin of the tænidia was very apparent, and it was their appearance which led me to examine the origin and mode of development of the so-called "spiral thread," and to endeavor to trace its relations to the intima (endotrachea) and peritoneal membrane (ectotrachea).

Fig. I is a longitudinal section through a secondary tracheal branch, showing the origin of the circular chitinous bands, or tænidia. At *t*′ are pieces of six tænidia which have been molted; *ectr* are the nuclei forming the outer cellular layer, the ectotrachea or peritoneal membrane. These nuclei send long slender prolongations around the inside of the peritoneal membrane; these prolongations, as may be seen by the figure, become the tænidia. The tænidia, being closely approximate, grow together more or less, and a thin endotracheal membrane is thus produced, of which the tænidia are the thickened band-like portions. The endotracheal membrane is thus derived from the ectotrachea, or

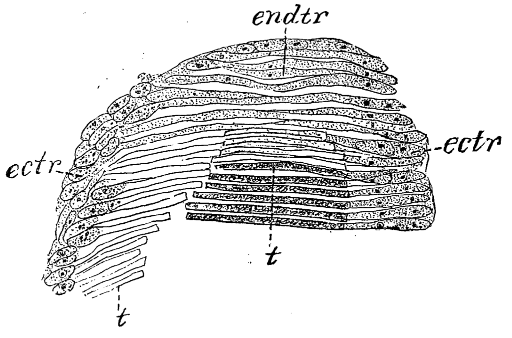

FIG. I.—Longitudinal section of a trachea, showing the origin of the tænidia or so-called spiral thread.

primitive tracheal membrane, and the so-called " spiral thread" is formed by parallel thickenings of the nuclei composing the secondary layer of nuclei, and which become filled with the chitin secreted by these elongated nuclei. The middle portion of the tænidia, immediately after the molt, is clear and transparent, with obscure minute granules, while the nuclear base of the cell is filled as usual with abundant granules, and contain a distinct nucleolus.

The origin of the tænidia is also well shown by Fig. 2, which is likewise a longitudinal section of a trachea at the point of origin of a branch. The peritracheal membrane or ectotrachea (*ectr*) is composed of large granulated nuclei; and within are the more transparent endotracheal cells; at *t'* are fragments of the molted tænidia. The new tænidia are in process of development at *t;* at base they are seen to be granulated nuclei, with often a distinct nucleolus, and sending a long slender, transparent, pointed process along the inside of the trachea. These unite to form the chitinous bands or so-called spiral threads.

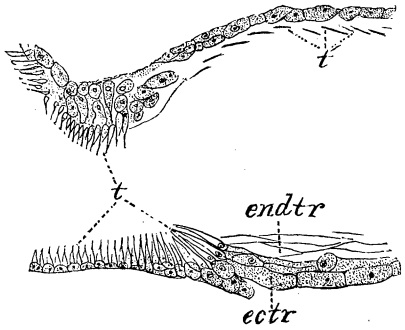

FIG. 2. Origin of the tænidia.

The tænidia I have found to be separate, independent, solid rings, more or less parallel and independent of each other. The supposed spiral arrangement I believe to be an optical illusion. The tænidia of a main branch stop at the origin of the smaller branches, and a new set begin at the origin of each branch. This fact also shows conclusively that the chitinous bands are not spiral. Nor do the tænidia at the origin of the branch pass entirely around the inside of the peritoneal membrane; in the axils they are short, separate, spindle-shaped bands.

The tænidia are usually thin, flat, but often slightly concavo-convex, the hollow looking towards the center of the trachea. I have been unable to find any forming incomplete hollow rings or tubules, like the pseudotrachea of the fly's tongue figured and described by Professor G. Macloskie.[1] It seems to me that the function of the tænidia is like that of the cartilaginous rings of the tracheæ of vertebrates, *i. e*, to keep the air-passage open so that the air may pass to the cells at the end of the trachea. All the figures of the spiral thread hitherto published I believe to be incorrect. In Guyon's work on *Pulex penetrans* they are represented to form a loose spiral, and so they appear at first glance under a low power in the tracheæ of the common flea of the cat. But on close examination, in an excellent preparation, the so-called spiral thread is a series of independent parallel tænidia, the spaces between them being wider than usual. In Fig. 3, from a preparation kindly presented to me by Mr. Justin Spaulding, *a* represents one of the first abdominal spiracles and the trachea arising from it; *b* the fifth; and *c* one of the last abdominal spiracles and its trachea. When the trachea bends or contracts in diameter the tænidia become less parallel, and a spiral appearance is produced. In the last pair the tænidia are remote from each other.

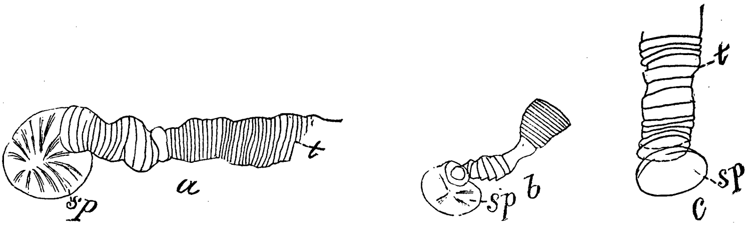

FIG. 3.—Stigma and trachea of Pulex.

In a preparation of one set of the salivary glands from the head of the honey bee, given me by Mr. Spaulding, the common duct is much like a trachea, having similar tænidia, and here they are observed to be parallel, independent bands.

The sections of Datana were made for me by Professor H. C. Bumpus of Olivet College.

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[1] Thus far I find myself unable to agree with Professor G. Macloskie that the "spirals of the proper tracheæ" are "crenulated thickenings of the intima," or that the tænidia are really tubular. In his valuable and suggestive article, "The Structure of the Tracheæ of Insects (AMER. NAT., XVIII, 567), I believe he has demonstrated the true nature of the pseudotracheæ of the fly. His criticisms of Chun's views and figures I believe, in the main, to be correct, but thus far I am unable to convince myself that the "external fissure" of the tænidia in the figure he copies from Chun, whose original essay I possess, is really such; it appears to be a new tænidium in process of formation previous to molting.